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This is a Rule 1.53(b) continuation of application 08/942,450

OMB No. 0851-0011 (12/31/86)

Applicant or Patentee: Brad A. Armstrong Attorney's
Serial or Patent No.: _____ Docket No.: _____
Filed or Issued: _____
For: GAME CONTROL WITH ANALOG PRESSURE SENSOR(S)

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY
STATUS (37 CFR 1.9 (f) and 1.27 (b)) — INDEPENDENT INVENTOR

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9 (c) for purposes of paying reduced fees under section 41 (a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled GAME CONTROL WITH ANALOG PRESSURE SENSOR(S) described in

☒ the specification filed herewith
☐ application serial no. _____, filed _____
☐ patent no. _____, issued _____

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☐ no such person, concern, or organization
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*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

FULL NAME ANASCAPE (a Nevada Limited Partnership)
ADDRESS 723 South Casino Center Blvd., 2nd Floor, Las Vegas NV 89125
☐ INDIVIDUAL ☒ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION


FULL NAME _____
ADDRESS _____
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FULL NAME _____
ADDRESS _____
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I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28 (b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Brad A. Armstrong

NAME OF INVENTOR	NAME OF INVENTOR	NAME OF INVENTOR
		
Signature of Inventor	Signature of Inventor	Signature of Inventor
<u>2-22-00</u>		
Date	Date	Date

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STATEMENT CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) & 1.27(c))--SMALL BUSINESS CONCERN

Docket Number (Optional)

Applicant, Patentee, or Identifier: Brad A. Armstrong, Inventor / Applicant

Application or Patent No.: _____

Filed or Issued: _____

Title: GAME CONTROL WITH ANALOG PRESSURE SENSOR(S)

I hereby state that I am

- ☐ the owner of the small business concern identified below:
☒ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF SMALL BUSINESS CONCERN ANASCAPE (a Nevada Limited Partnership)

ADDRESS OF SMALL BUSINESS CONCERN 723 South Casino Center Blvd., 2nd Floor
Las Vegas, NV 89125-2346

I hereby state that the above identified small business concern qualifies as a small business concern as defined in 13 CFR Part 121 for purposes of paying reduced fees to the United States Patent and Trademark Office. Questions related to size standards for a small business concern may be directed to: Small Business Administration, Size Standards Staff, 409 Third Street, SW, Washington, DC 20416.

I hereby state that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention described in:

- ☒ the specification filed herewith with title as listed above.
☐ the application identified above.
☐ the patent identified above.

If the rights held by the above identified small business concern are not exclusive, each individual, concern, or organization having rights in the invention must file separate statements as to their status as small entities, and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization having any rights in the invention is listed below:

- ☐ no such person, concern, or organization exists.
☒ each such person, concern, or organization is listed below.

Brad A. Armstrong, Inventor; A small entity attached therefore.

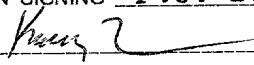
Separate statements are required from each named person, concern or organization having rights to the invention stating their status as small entities. (37 CFR 1.27) Attached

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NAME OF PERSON SIGNING Kelly Tyler

TITLE OF PERSON IF OTHER THAN OWNER General Partner / Manager

ADDRESS OF PERSON SIGNING P.O. Box 841, Jamul, CA 91935

SIGNATURE  DATE Feb. 22, 2000

jc564 U.S. PRO

09/510572

02/22/00

Signature of one making deposit:

~~Brad A. Armstrong, Inventor~~

Patent Application of
Brad A. Armstrong
for
GAME CONTROL WITH ANALOG PRESSURE SENSOR(S)

5 This is a Rule 1.53(b) continuation application of my
pending U.S. Application 08/942,450 filed 10/01/1997, now
U.S. Patent _____ (to be filled in later), to
which the benefit of the earlier filing date is claimed
for the common matter.

10 BACKGROUND OF THE INVENTION

1. Field of the Invention:

 The present invention relates to controllers of the
type used and held by two hands simultaneously to control
visual imagery shown on a visual display. More
15 specifically, the present invention pertains to a two hand
held controller with analog pressure sensor(s) for
controlling video game imagery thereof, and other
electronically generated imagery. Methods of use and
manufacturing are also disclosed.

20 2. Description of the related Prior Art:

 There are many prior art game controllers for use in
controlling imagery. A typical prior art game controller
is shown in U.S. Patent 5,207,426 issued May 4, 1993 to Y.
Inoue et al and assigned to Nintendo Co. Ltd. The
25 Nintendo controller is a typical example of a game
controller having multiple inputs capable of manipulating
multiple-axes, such as with the included cross-shaped
rocker key pad, and numerous buttons and depressible
surfaces. The Nintendo controller includes a housing
30 sized to be grasped and held simultaneously by two hands
of a human user with thumbs of the grasping hands

remaining free of grasping responsibilities; the housing including a right-hand area and a left-hand area, the right-hand area being an area for grasping by the user's right hand, the left-hand area being an area for grasping by the user's left hand; a plurality of depressible surfaces (e.g., buttons and cross-shaped key pad) each at least in-part supported by the housing and each at least in-part exposed on the housing in at least one area for operation by the user's thumbs and fingers. The plurality of depressible surfaces (most of the depressible surfaces) are positioned on the housing to be within reach of the user's thumbs with the user's hands grasping the housing; each depressible surface or member of the plurality of depressible surfaces or members is individually operatively associated with an individual electricity manipulating device (e.g., a simple momentary-On switch to close an opening in a circuit), one electricity manipulating device per each depressible surface of the plurality of depressible surfaces. Each electricity manipulating device (momentary-On switch) is contained at least in-part within the housing and capable of electrical output manipulation upon physically applied depressive pressure on the associated depressible surface. The switches (electricity manipulating devices) are either On or Off and provide corresponding all or nothing outputs. These simple On/Off switches are not used to provide the user proportional or analog control.

Although there have been tens of millions of such prior art controllers as described above sold by numerous manufacturers despite the significant disadvantages of simple On/Off controls, I believe such a controller can be improved, so does Nintendo Co. Ltd. In a more recent game controller sold by Nintendo, referred to as the N64 controller, the controller has incorporated in a center portion a proportional joystick having rotary optical encoders to achieve the proportional effect. The

proportional joystick is applied in an attempt to overcome the significant disadvantages of the four simple On/Off switches located under the typical cross-shaped rocker pad. The proportional joystick includes at least two
5 major disadvantages which are overcome by the present invention. The first disadvantage is cost of manufacture, and the second is confusion of the user. In a controller to be made in millions of units, two relatively expensive optical encoders, a complex gimble, multiple mechanical
10 parts specific for the joystick, etc. creates an additional substantial cost which is very high. The second disadvantage is confusion of the user in that the typical user has become commonly accustomed to use of the cross-shaped key pad with the left thumb. The
15 presentation of the option of the proportional joystick with the N64 controller often leads to confusion as to whether to use the cross-shaped key pad or the joystick, especially for beginning users and potential buyers.

Clearly there is great advantage to the user's
20 enjoyment of the game by allowing the user proportional or variable control.

The primary emphasis of this disclosure is to teach analog pressure sensor(s) embodiment in a controller having only a single housing structured to be held in the
25 user's two hands simultaneously. Nevertheless, a joystick type of controller can be greatly advantaged by embodiment of analog sensors as described herein. The joystick type controller may be held in two hands simultaneously but it is not a single housing held in two hands. Rather, a
30 joystick includes two housings, a base housing and a handle housing neither of which are designed to be held in two hands simultaneously. The joystick type controller may be greatly advantaged by inclusion of depressible surfaces (buttons and/or triggers) operating analog
35 sensors as described herein. Such embodiments will become apparent to those skilled in the art with a study of this

disclosure. On the other hand, mouse type controllers have a single housing but the single housing is not designed to be held in two hands simultaneously and therefore such type controllers are not considered
5 relevant to the present invention.

Other related prior art of which I am aware and believe to be cumulative to the aforementioned includes the following U.S. Patent: 4,687,200 issued Aug. 18, 1987; 5,644,113 issued July 1, 1997; 5,602,569 issued Feb. 11,
10 1997; 4,469,330 issued Sept. 4, 1984; 5,459,487 issued Oct. 17, 1995. Also U.S. Patents 5,565,891 issued Oct. 15, 1996 and 5,589,828 issued Dec. 31, 1996 to the present Inventor.

The present invention solves the aforementioned
15 disadvantages and provides significant additional benefits and advantages.

SUMMARY OF THE INVENTION

The following summary and detailed description is of preferred structures and best modes for carrying out the
20 invention, and although there are clearly variations which could be made to that which is specifically herein described and shown in the included drawings, for the sake of brevity of this disclosure, all of these variations and changes which fall within the true scope of the present
25 invention have not been herein detailed, but will become apparent to those skilled in the art upon a reading of this disclosure.

The present invention involves the use of structures (pressure sensors) having pressure-sensitive variable-
30 conductance material across proximal circuit traces in order to provide variable output. Such variable output is useful for control of action intensity of electronic imagery in proportion to applied physical pressure in the depression of familiar control surfaces of a two hand held
35 game controller. Improved methods pertaining to using and

manufacturing game controllers are also herein disclosed.

Applied physical pressure is provided by a user of the present controller depressing a button or like depressible surface (e.g., cross-shaped key pad or finger depressible trigger which is commonly a pivotal member) which applies pressure onto pressure-sensitive variable-conductance material which, dependant upon the applied pressure, alters its conductivity (i.e., resistive or rectifying properties dependant on pressure sensor material utilized) and thereby provides analog electrical output proportional to the applied pressure. The analog electrical output of the variable-conductance material is output to an image generation machine as a signal at least representational of the analog electrical output for controlling electronic imagery.

Examples of use of the invention (controller) in a game for control of action intensity of the electronic imagery can be to simply have a simulated character walk with low depressive pressure applied, walk faster with increased depressive pressure applied, and run with a relatively high depressive pressure applied to a single depressible surface depressible individual button of the controller in accordance with the present invention. The user can choose the action intensity of imagery by applying appropriate depressive pressure to depressible surfaces of the depressible individual buttons of the controller. In a second example, a race car can veer slightly with a low depressive pressure and turn sharply with a high depressive pressure. In an example of typical right thumb use (or finger of the right hand as is typical in joystick use) of the controller, variable depressive pressure can control variable fire rate of a gun or variable jumping height of a character, etc.

The present invention in one embodiment involves a game controller sized and shaped to be grasped and held simultaneously by two hands of a human user with thumbs of

the grasping hands remaining substantially free of grasping responsibilities. The thumbs are used in depressing a plurality of depressible surfaces, the depressible surfaces each at least in-part exposed on the housing outer surface. A plurality of electricity manipulating devices are contained within the housing in operable association with the plurality of depressible surfaces for manipulating electrical outputs with depression by the thumbs (or fingers) of the plurality of depressible surfaces and physical pressure applied by the depression. One or more of the electricity manipulating devices are analog pressure-sensitive variable-conductance electrical devices (sensors) for varying electrical output proportional to varying physical pressure applied by the user's thumb or fingers.

The controller of this disclosure, which can be used and manufactured as herein described, is a controller which the user holds or grasps in both hands simultaneously during operation (depressing of depressible surfaces) of the controller, and the two handed holding provides advantages for certain imagery manipulations which cannot be obtained with single hand held controllers such as a mouse. The ability to use and the actual use of two hands simultaneously on a controller allows what I call "full involvement" of the user, wherein the user can involve both hands in the control of imagery and utilizing, in general terms, the specialized abilities of the differentiated halves of his or her brain. Typically the left half of the brain of a user mostly controls the right arm and hand, and the right half of the brain mostly controls the left arm and hand. Generally speaking, for most users of a controller, it is much more intuitive and natural to use the right hand digits for certain types of control functions, such as for example, critical timing of functions such as those associated with firing a simulated gun, or precise timing in jumping of a simulated character

of an electronic game. Typically, the left hand and digits are used to control functions which are more spatial in nature, such as for aiming functions which might be associated with steering a simulated car, airplane or controlling directional movement of a character such as the running direction of a simulated person. The present two hand held controller allows for placement of depressible control surfaces for certain functions in areas of the controller which are generally most suitable for typical human users. Additionally, a two handed controller provides the user the advantageous ability to hold the controller in both hands with the controller in the user's lap or held in front of the user and free of the constraints of needing a desk top or like surface on which to rest the controller.

An object of the present invention is to provide a game controller having thumb or finger (digit) depressible pressure-sensitive proportional (i.e. analog) control(s), thus the user can control the action intensity of the game imagery by the degree of pressure exerted on a depressible surface.

Another object of the present invention is to provide the above in a structural arrangement familiar to current game controller users, thus no secondary expensive proportional joystick is required when proportional controls are applied to a cross-shaped rocker key pad.

Another object of the present invention is to provide an inexpensive to manufacture analog input controller.

Another object of the present invention is to provide a game controller in which right hand thumb buttons may also be pressure-sensitive proportional (analog input) control(s).

Another object of the present invention is to provide an improved method of using a game controller connected to an image generation machine with visual display, in which a user depresses depressible surfaces using hand digits on

a game controller to manipulate imagery on the display, wherein depressing of at least one of the depressible surfaces with varying degrees of pressure manipulates imagery of the display in proportion to the degree of depressive pressure.

Another object of the present invention is to provide a method of controlling action intensity of imagery within a visual display of the type associated with an electronic game allowing user manipulation of action of imagery within the visual display by way of depressing a depressible surface onto a pressure-sensitive variable-conductance sensor connected to electronics within a two hand held game controller linked to an image generation machine such as a game console or computer which in turn is linked to the display, and wherein depressing of a depressible surface with varying degrees of pressure varies the conductance of the pressure-sensitive variable-conductance sensor, thereby the action intensity of the imagery can be proportional to the degree of depressive pressure.

Another object of the present invention is to provide an improved method of manufacturing a two hand held type game controller including installing pressure-sensitive variable-conductance material for varying electrical output of circuitry in proportion to user applied pressure to a depressible surface.

These, as well as additional objects and advantages will become increasingly appreciated with continued reading and with a review of the included drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a traditional prior art game controller commonly referred to as a game pad having a left hand area and a right hand area with the left hand area having a cross-shaped rocker pad depressible in four codependant areas, under each area is an associated On/Off momentary-

On switch (electricity manipulating devices), four switches, one under each depressible area. The right hand area has depressible individual buttons located over On/Off momentary-On switches (electricity manipulating devices).

Fig. 2 shows a Nintendo N64 prior art game controller. This controller illustrates the growing need for variable or analog input control in the incorporation of the complex rotary encoder joystick. This controller has typical traditional right hand area depressible buttons and also a typical cross-shaped depressible rocker pad in the left hand area.

Fig. 3 shows a cross section view of a resilient dome cap mounted over a circuit board having a first and a second circuit trace including pressure-sensitive variable-conductance material in a sensor arrangement in accordance with the present invention.

Fig. 4 shows a top view of first and second conductive traces with finger-like traces laying opposed in proximity with one another.

Fig. 5 shows a cross sectional view of a resilient dome cap operatively associated with pressure-sensitive variable-conductance material atop interdigitated traces on a circuit board in accordance with the present invention.

Fig. 6 shows a top view of first and second interdigitated circuit traces.

Fig. 7 shows a cross sectional view of a resilient dome cap supporting and operatively associated with pressure-sensitive variable-conductance material above interdigitated traces on a circuit board in accordance with the present invention.

Fig. 8 shows the sensor of Fig. 7 in a depressed or activated state.

Fig. 9 shows an exploded view of one controller in accordance with the present invention.

Fig. 10 is a graph illustrating depressive pressure in relation or in proportion to the conductivity of a pressure sensor, which typically corresponds to action intensity of imagery on the game display.

5 Fig. 11 shows a game controller of a traditional format in accordance with the present invention for example. The game controller is shown connected by wires to an image generation machine (game console or personal computer) which drives a display such as a television or
10 computer monitor.

BEST MODES FOR CARRYING OUT THE INVENTION

Referring now to drawing figures 3-11 for descriptions of preferred embodiments and best modes for carrying out the invention. As previously mentioned, the
15 present invention includes a game controller which is a two hand held controller sized and shaped to be grasped and held simultaneously by two hands of a human user with thumbs of the grasping hands remaining substantially free of grasping responsibilities so as to be available and
20 useful in depressing a plurality of depressible surfaces 22 each at least in-part exposed on housing 20 to be accessible by the user's digits. A plurality of electricity manipulating devices 24 are contained (or at least in part contained) within housing 20 in operable
25 association with the plurality of depressible surfaces 22 for manipulating electrical outputs with depression by the user's hand digits (thumbs or fingers) of the plurality of depressible surfaces 22. Electricity manipulating devices 24 in this disclosure can be any electrical device such as
30 simple Off/On (momentary-On) switches as are commonly used in prior art game controllers, but with the present invention at least one of the electricity manipulating devices 24 is an analog pressure-sensitive variable-conductance sensor 26 for varying electrical output
35 proportional to varying physical pressure applied by the

user's thumb or fingers on a depressible surface 22 positioned to apply pressure to pressure-sensitive variable-conductance material 36 of sensor 26 as will be detailed.

5 Shown in Fig. 3 is a pressure-sensitive variable-conductance sensor 26 or analog sensor as it may installed by a manufacturer within a game controller in accordance with the present invention. Resilient dome cap 28 is shown made of rubbery material, such as injection molded
10 silicone rubber, mounted over a circuit board 30 having a first circuit trace 32 and a second circuit trace 34 and including pressure-sensitive variable-conductance material 36 contacting both traces 32, 34, and an electrically
15 conductive plate 38 is shown atop pressure-sensitive variable-conductance material 36. An underside portion of depressible surface 22 is shown atop dome cap 28. Dome cap 28 is a resilient dome providing a return spring lifting depressible surface 22 and provides or serves the purpose in this example of supporting depressible surface
20 22 raised upward until manually depressed to cause the lower or inner surface of dome cap 28 to press against plate 38 which in turn presses against pressure-sensitive variable-conductance material 36 which, as will be detailed, changes its conductivity with applied pressure
25 to alter the conductance of the electrical path provided thereby between the first and second conductive traces 32 and 34 which are in close proximity to one another yet separated. Sensor 26 can be used in replacement of a simple momentary-On switch within a game controller
30 wherein a momentary-On switch simply closes the circuit across the first and second traces 32 and 34 while the user presses on depressible surface 22 and the closed circuit outputs a known and fixed output (On or Off, or open or closed), while with the application of sensor 26
35 depressing of depressible surface 22 provides variable electrical flow across the first and second circuit traces

32, 34 varying in proportion to the degree of depressive pressure applied by the user's thumb or finger on the top or upper exposed portion of depressible surface 22. Such an arrangement allows a voltage/current to be applied to first circuit trace 32 wherein current flows from first circuit trace 32 through pressure-sensitive variable-conductance material 36 into conductive plate 38 through pressure-sensitive variable-conductance material 36 and into second circuit trace 34. Voltage/current can be regulated and varied by way of applied physical pressure such as onto plate 38 to compress material 36 which alters the conductivity of the circuit at least in-part defined by circuit traces 32 and 34.

Pressure-sensitive variable-conductance material 36 is an important aspect of the present invention. Variable conductance can be achieved with materials having either variable resistive properties or variable rectifying properties. For the purpose of this disclosure and the claims, variable-conductance means either variably resistive or variably rectifying. Material having these qualities can be achieved utilizing various chemical compounds or formulas some of which I will herein detail for example. Additional information regarding such materials can be found in U.S. patent 3,806,471 issued to R.J. Mitchell on April 23, 1974 describing various feasible pressure-sensitive variable-conductance material formulas which can be utilized in the present invention. While it is generally anticipated that variable resistive type active materials are optimum for use in the pressure sensor(s) in the present invention, variable rectifying materials are also usable.

An example formula or compound having variable rectifying properties can be made of any one of the active materials copper oxide, magnesium silicide, magnesium stannide, cuprous sulfide, (or the like) bound together with a rubbery or elastic type binder having resilient

qualities such as silicone adhesive or the like.

An example formula or compound having variable resistive properties can be made of the active material tungsten carbide powder (or other suitable material such as molybdenum disulfide, sponge iron, tin oxide, boron, and carbon powders, etc.) bound together with a rubbery or elastic type binder such as silicone rubber or the like having resilient qualities. The active materials may be in proportion to the binder material typically in a rich ratio such as 80% active material to 20% binder by volume ranging to a ratio 98% to 2% binder, but can be varied widely from these ratios dependant on factors such as voltages to be applied, level or resistance range desired, depressive pressure anticipated, material thickness of applied material 36, surface contact area between material 36 and conductive traces such as traces 32 and 34, whether an optional conductive plate such as plate 38 is to be used, binder type, manufacturing technique and specific active material used.

A preferred method of manufacture for portions of that which is shown in Fig. 3 is to create a sheet of pressure-sensitive material 36 adhered to a conductive sheet such as steel, aluminum or copper, for example, by applying a mixture of the still fluid material 36, before the binder material has cured to the conductive sheet in a thin even layer. After the binder material (material 36) has cured and adhered to the conductive sheet, a hole punch is used to create circular disks of the lamination of the conductive sheet (plate 38) adhered to material 36. The disks may then be secured to the circuit board and in contact with circuit traces 32 and 34. Securing may be accomplished with the use of adhesives such as the same binder such as silicone rubber or adhesive as used in the formula to make material 36.

Depressible surface 22 can be a button 40 style depressible member such as shown in Figs. 9 and 11, or

depressible surface 22 can be an end portion of a four-way rocker or four-way key pad 42 as shown in Figs. 9 and 11. For further clarity, depressible surface 22 and electricity manipulating device 24 are herein described and shown as separate elements, but they are only necessarily separate in a functional sense (i.e., physical depressing function verses electrical controlling function). In practical application, depressible surface 22 and electricity manipulating device 24 may be structured as one part. For example, the upper part of dome cap 28 protruding through housing 20 could itself be exposed to contact by a hand digit to function as the depressible surface 22 as shown for example in Figs. 7 and 8.

Fig. 4 shows first and second electrically conductive traces 32, 34 with finger-like traces laying in proximity with one another which can be the form of the first and second conductive traces 32, 34 of Fig. 3. The spacings between the conductive finger-like trace elements shown in Fig. 4 allow for adhesive which can be used to adhere a layer or disk of pressure-sensitive variable-conductance material 36 to circuit board 30 if so desired by the manufacturer.

Shown in Fig. 5 is a second pressure-sensitive variable-conductance sensor 26 or analog sensor embodiment as it may be installed by a manufacturer within a game controller useful with the present invention. Resilient dome cap 28 is mounted over circuit board 30 having first and second circuit traces 32, 34 and including pressure-sensitive variable-conductance material 36 contacting both traces 32, 34. Optional plate 44 is shown atop pressure-sensitive variable-conductance material 36. An underside portion of depressible surface 22 is shown atop dome cap 28. Depressible surface 22 is shown in-part supported by housing 20, which in this example is housing 20 providing lateral support against the side of surface 22 and

additionally with surface 22 including a lower flange
 abutting the underside of housing 20 and thereby being
 prevented from escaping housing 20. Optional plate 44 in
 this arrangement can be a stiff plate utilized as a
 5 physical load distributor to distribute compressive loads
 received from the underside of dome cap 28 with depression
 of depressible surface 22 across material 36 and not be an
 electrical conductor, or alternatively it can also be an
 electrical conductor dependant upon the particular
 10 thickness of material 36 and or spaced distance between
 circuit traces 32 and 34 beneath material 36. Plate 44
 does not have to be applied atop material 36 in all
 embodiments. Circumstances which effect the determination
 as to whether plate 44 or conductive plate 38 for that
 15 matter are used atop material 36 include: the particular
 formula of material 36; dimensions of the applied material
 36; the size, shaped proximity and layout of the circuit
 traces in contact with material 36, and manufacturing
 considerations such as is material 36 directly applied to
 20 plate 44 or 38 in an easily handled disk and then adhered
 to the circuit board 30, or applied directly to circuit
 board 30 and traces 32, 34 such as by application in a
 fluid mixture (uncured) using a removable mask; or
 directly injected onto circuit board 30 such as with
 25 injection molding; or a pill/disk of material 36 is sliced
 from a cured cylinder or extrusion of material 36 and the
 pill/disk adhered to circuit board 30 and/or traces 32,
 34; and other manufacturing techniques.

Fig. 6 shows a top view of closely interdigitated
 30 circuit traces 32 and 34 in a form as may likely be used
 in the sensor structures shown in Figs. 5, 7 and 8.

Shown in Figs. 7 and 8 is a third pressure-sensitive
 variable-conductance sensor 26 formed as a depressible
 individual button which is an analog sensor embodiment as
 35 it may be installed by a manufacturer within a game
 controller or used by a user of the game controller in

accordance with the present invention. Rubber dome cap 28 is mounted over circuit board 30 having first and second circuit traces 32, 34 and including pressure-sensitive variable-conductance material 36 on the bottom side of resilient dome cap 28. An upper exposed portion of dome cap 28 is exposed exterior of housing 20 so that depression by a thumb or finger of depressible surface 22 causes downward movement or depression of dome cap 28 to bring material 36 into contact with traces 32 and 34.

Depressible surface 22 is shown in-part supported or laterally stabilized by housing 20. Material 36 is not permanently contacting traces 32 and 34 as is shown in Fig. 3 and 5, but instead is on the underside of dome cap 28 in pill or disk form and raised or held upward above traces 32, 34 by dome cap 28 until, as indicated in Fig. 8, surface 22 is depressed to push dome cap 28 downward to bring material 36 into contact with traces 32, 34 which, under pressure, establishes a conductive path across traces 32, 34. Also shown in Figs. 7 and 8 is the surface of material 36 which contacts traces 32 and 34 is convexed which in this particular application provides for the apex of the surface to first contact across traces 32 and 34 followed by material 36 which is flexible deforming with additional applied pressure to somewhat flatten-out and contact additional surface area of both traces 32 and 34. This arrangement of relatively lower initial surface area contact followed by additional or a larger surface area contact with further depression can provide additional conductivity changes due to not only the inherent conductivity changes brought about by pressure applied to material 36 but also by establishing additional current paths possible by the additional surface contact area. Material 36 in Fig. 7 and 8 can be formed with a flat bottom surface and function adequately without the increasing surface area effect provided by the convexed shape shown. Additionally sensors 26 of Figs. 3, 5, 7 and

8 will function within the scope of the invention absent the spring return effect of dome cap 28 wherein material 36 shown in Fig. 7 would be resting upon traces 32 and 34 and actuated by depression of surface 22.

5 In the prior art, typically a carbon-rich conductive pill or disk is located on the underside of a typical dome cap such as dome cap 28. In the prior art carbon-rich conductive pills are employed as simple On/Off momentary-On switches wherein the pill is depressed by the user onto
10 and across circuit traces to close the circuit and released to open the circuit. In the prior art, the carbon-rich pill is a component of a switch that is only an On/Off switch. The prior art carbon-rich conductive
15 switch with the improvement being that this is considered a bounce-less switch not subjecting the circuitry to rapid on/off oscillations at the time of initial depression. Carbon-rich pills are typically made of granular carbon in high concentrations in a silicone rubber binder producing
20 a resilient conductive material resistant to mechanical bouncing when depressed onto a surface. The carbon-rich pill is utilized to advantage in a simple On/Off bounce-less switch.

Such a carbon-rich pill, to my knowledge, has never
25 been used or anticipated to be used for an analog sensor to provide action intensity control of electronic imagery. Neither, to my knowledge, has such a carbon-rich pill ever been used or anticipated to be used for an analog sensor in a two hand held game controller. I have discovered
30 that such a carbon-rich pill or disk can be used, in a novel manner as taught herein, as an analog sensor in a game controller to provide action intensity control of electronic imagery such as that associated with electronic games. However, a narrow range of resistivity change
35 found in a typical prior art carbon-rich pill as a function of depressive pressure exerted makes it not an

ideal choice as an analog sensor in a human hand operated controller.

In the range of light depression by a typical user's thumb or finger (i.e., approximately one to six ounces) a carbon-rich pill as a variable resistor may typically have a range of resistance from a high value of approximately 3 thousand ohms to a low value near 10 ohms, which is a narrow range compared to a tungsten carbide based material 36 which may typically have a range from approximately 3 million ohms down to a low of approximately 10 ohms. Thus, the tungsten carbide based material 36 has a range of nearly 3 million ohms, while the carbon-rich pill has a range of nearly 3 thousand ohms, resulting in an improvement of three magnitudes (i.e., one thousand times) in range of the tungsten carbide material 36 over the carbon-rich pill.

Tungsten carbide having an extreme resistance range as a function of physical depressive pressure allows for greater variation (higher resolution) of physical pressure applied within those levels normal to light use by the thumb or finger of a typical human user. The variable resistance range of tungsten carbide is additionally quite stable over a wide temperature range. Tungsten carbide also has excellent wear characteristics and minimal hysteresis. Therefore, tungsten carbide is a preferred active material for use with the present invention.

Within the scope of the invention, material 36 can be manufactured and fixed in place with numerous processes not yet detailed, and for example, tungsten carbide can be mixed with un-crosslinked silicone rubber and extruded from a tool or pressed into a cylindrical mold, allowed to crosslink, and then cut or sliced into disks or pills of material 36 which can then be placed in appropriate location to circuit traces 32, 34 or on dome cap 28. Another process is to mix tungsten carbide or other suitable material with an injection moldable silicone

rubber and then inject the material onto any desireable surface such as a membrane surface such as mylar, or circuit board 30 and traces 32, 34, or using an injection process for creating dome cap 28 with disks or pills of material 36 thereon, such as could be performed for the dome cap 28 and material 36 arrangement of Fig. 7 and 8, or dome cap 28 can be a flexible/resilient dome cap and material 36 can be molded either onto the dome cap or onto the circuit board, etc. If a metal dome cap is used and is electrically conductive, one circuit trace such as trace 32 can make electrical contact with a foot of the dome cap and the second trace below the approximate center of the dome cap with material 36 positioned between the second trace and the center of the dome cap such that depression of the dome cap effectively sandwiches material 36.

Fig. 9 shows an exploded view of a controller in accordance with one embodiment of the present invention. Shown at the top of the view is an upper portion 50 of housing 20. Upper portion 50 of housing 20 includes on the right hand side a pair of circular holes 52 for receiving and in-part supporting (retaining) depressible surfaces 22 which in this example are buttons 40. On the left hand side of the housing top is a cross-shaped opening 54 through the housing for in-part receiving and supporting a four-way rocker 42 which is a depressible surface 22. The depressible surfaces when assembled into the housing are in-part exposed on the housing surface for depressing by the digits of the human hands. Shown below the housing upper portion 50 is rocker 42 and buttons 40. Additionally shown are individual rubber dome caps 28 beneath button 40 and a four-gang rubber dome cap 28 beneath rocker 42 having four codependant areas. Shown beneath the rubber dome caps is circuit board 30 having on its left side an array of circuit traces forming four areas including adjacent circuit traces 32 and 34 in close

proximity to one another for operative engagement with material 36 installed by the manufacturer atop each of the four areas which are located such that the four-gang rubber dome cap can be applied over the four locations of material 36 to provide a dome cap over each material 36 location. Rocker 42 can then be located atop the four-gang rubber dome cap so that one dome cap is located underneath each one of the four arm structures (four codependant areas) of rocker 42. Each arm of rocker 42 is placed one arm above each of the four locations of material 36. Rocker 42 is supported elevated above material 36 by dome caps, and when housing 20 is fully assembled with a lower portion 56 of housing, a flange 58 on the lower outward edge of rocker 42 prevents rocker 42 from completely passing through cross-shaped hole 54. Shown on the right side of circuit board 30 are two locations of applied material 36 installed by the manufacturer over separated yet in close proximity to circuit traces 32 and 34. The two individual dome caps 28 will be placed one over each material 36 location of the right side of the board 30, and button 40 positioned onto dome caps 28, the upper surfaces of buttons 40 positioned through holes 52 and housing 20 and circuit board 30 connected to one another and housing 20 closed with upper portion 50 and lower portion 56 affixed together. Also shown on circuit board 30 is circuit traces 32 and 34 connecting to active electronics 46 installed by the manufacturer and electronics 46 having the capacity to output a signal at least representational of the analog electrical output of pressure-sensitive variable-conductance sensor(s) 26 into output cable 48 leading to an image generation machine 60 such as a game console or computer connected to a display (Fig. 11). Active electronics 46 (i.e., ASIC or micro-controller integrated circuitry, etc.) which in addition to having normal circuitry of a typical game controller such as a prior art

controller also has circuitry for interpreting the analog output of sensor material 36 and converting it into a digital signal (if a digital signal is desired) which is output to a host graphic generation machine via cable 48.

5 For the sake of brevity and because it is well known to those skilled in the art, this disclosure does not detail converting analog to digital signals, i.e., specifically converting the output of sensors 26 to a digital signal or form for control of imagery. It is conceivable that
10 within the scope of the invention, circuit traces 32 and 34 could simply be connected directly to conductors of cable 48 for outputting a signal at least representational of the analog electrical output of pressure-sensitive variable-conductance sensor(s) 26 through output cable 48
15 into an image generation machine 60 wherein active electronics 46 may be located.

Fig. 10 shows an idealized graph indicating conductivity of pressure-sensitive variable-conductance sensor such as sensor 26 and the corresponding action
20 intensity of imagery in a game machine as a function of depressive pressure exerted by the thumb or fingers (digit) onto the depressible surfaces of a game controller as herein described. The graph shows that with a low depressive pressure, the conductivity is also low
25 (resistivity high), and action intensity of imagery would normally be arranged to be low since the typical user will normally naturally associate low applied pressure with low action intensity. As depressive pressure increases so also increases the conductivity (resistivity lowering)
30 proportionally in a smooth continuous change or analog manner so as to provide a variable electrical output.

Examples of typical left thumb use of the invention in a game can be to simply have a simulated character shown on the display walk with low depressive pressure
35 applied to a depressible surface 22 of sensor 26, walk faster with increased depressive pressure applied to the

depressible surface 22, and run with a relatively high depressive pressure applied to the same depressible surface 22, with this being an example of controlling or changing the action intensity of the imagery

5 proportionally with changes in depressive pressure applied to depressible surface 22 of sensor 26. The user can choose the action intensity of imagery by applying appropriate depressive pressure. In a second example, a race car can veer slightly with a low depressive pressure applied to surface 22 of sensor 26 and turn sharply with a
10 high depressive pressure applied to the same depressible surface 22. In a typical right thumb use and an example of use of the invention, variable depressive pressure can control variable fire rate of a gun or variable jumping
15 height of a character shown as an image on display 62. Alternatively, the invention in combination with an electronic game console or PC and display can be arranged so the action intensity of the imagery is reduced proportionally to increases or increasing depressive
20 pressure applied on depressible surface 22 of sensor 26 wherein a simulated race car shown on the display travels at a high rate with little or no depressive pressure applied to surface 22, and is slowed proportionally to increased or increasing depressive pressure applied by the
25 user to the depressible surface 22 of sensor 26, an arrangement wherein the sensor 26 is applied as a braking system.

Fig. 11 shows a game controller of a traditional format in accordance with the present invention for
30 example. The game controller is shown connected by cable 48 to an image generation machine 60 such as a game console or personal computer which drives a display 62 such as a television, computer monitor or head-mount display, etc.

35 Although I have very specifically described preferred structures and best modes (methods) of the invention, it

should be understood that the specific details are given for example to those skilled in the art. Many changes in the described specifics can clearly be made without departing from the scope of the invention, and therefore

5 it should be understood that the scope of the invention is not to be overly limited by the specification and drawings given for example, but is to be determined by the spirit and scope and broadest possible interpretation of the attached claims.

I claim:

1. An improved method of controlling action intensity of a simulated game character by way of depressing at least one depressible single button located
5 on a two-hand held housing, said single button for activating one single pressure-sensitive analog sensor, said pressure-sensitive analog sensor electrically connected to electronics, said electronics including means for controlling a display, said display for displaying
10 said simulated game character;

wherein the improvement includes the step
depressing, using a digit of a human user's hand, said depressible single button with varying degrees of pressure for varying the action intensity of said
15 simulated game character.

2. An improved method of controlling action intensity of a simulated game character according to claim 1 wherein said action intensity is at least represented by movement speed of said game character, whereby said game
20 character moves slowly with low depressive pressure applied to said button, said game character moves faster with increased depressive pressure applied to said button.

3. An improved method of controlling action intensity of a simulated game character according to claim
25 1 wherein said action intensity is at least represented by jumping height of said game character, whereby a human user depresses said button using low depressive pressure causing said character to jump a low height, and the human user depresses said button using higher depressive
30 pressure causing said character to jump a higher height.

4. An improved method of controlling action intensity of a simulated game character according to claim
1 wherein said game character is a simulated car, said car is slowed proportionally to increasing depressive pressure
35 applied by the user to said button.

5. An improved method of controlling action intensity of a simulated game character according to claim 1 wherein said game character is a simulated gun, said varying degrees of pressure for varying fire rate of said gun.

6. An improved method of controlling action intensity of a simulated game character by way of depressing at least one single depressible button, using only a single digit of a human user's hand, said single depressible button for activating a single sensor; wherein the improvement includes the step

depressing said depressible button with varying degrees of pressure for varying the action intensity of said simulated game character.

7. An improved method of controlling action intensity of a simulated game character according to claim 6 wherein said action intensity is at least represented by movement speed of said game character, whereby said game character moves slowly with low depressive pressure applied to said button, said game character moves faster with increased depressive pressure applied to said button.

8. An improved method of controlling action intensity of a simulated game character according to claim 6 wherein said action intensity is at least represented by jumping height of said game character, whereby a human user depresses said button using low depressive pressure causing said character to jump a low height, and the human user depresses said button using higher depressive pressure causing said character to jump a higher height.

9. An improved method of controlling action intensity of a simulated game character according to claim 6 wherein said game character is a simulated car, said car is slowed proportionally to increasing depressive pressure applied by the user to said button.

10. An improved method of controlling action intensity of a simulated game character according to claim

6 wherein said game character is a simulated gun, said
varying degrees of pressure for varying fire rate of said
gun.

8. A game control comprising

5 a housing to be grasped and held simultaneously by
two hands of a human user during use, said housing
including a right-hand area and a left-hand area, said
right-hand area being an area for grasping by the user's
right hand, said left-hand area being an area for grasping
10 by the user's left hand;

a plurality of depressible electricity manipulating
devices each at least in-part exposed on said housing, at
least some of said plurality of electricity manipulating
devices positioned on said housing to be within reach of
15 the user's right-hand thumb;

at least one of said electricity manipulating devices
including means for creating an analog electrical signal
representing varying applied physical pressure;

at least one of said electricity manipulating devices
20 including means for creating an On/Off signal; each of
said electricity manipulating devices electrically
connected to

electronics means for at least reading the signals of
said electricity manipulating devices.

25 12. A game control according to claim 11 wherein
said electronics means includes an ASIC.

13. A game control according to claim 11 wherein
said at least one of said electricity manipulating devices
including means for creating an analog electrical signal
30 representing varying applied physical pressure, and said
at least one of said electricity manipulating devices
including means for creating an On/Off signal, are a
single said electricity manipulating device.

14. A game control according to claim 13 wherein
35 said electronics means includes an ASIC.

15. A game control comprising

a housing to be grasped and held simultaneously by two hands of a human user during use, said housing including a right-hand area and a left-hand area, said
 5 right-hand area being an area for grasping by the user's right hand, said left-hand area being an area for grasping by the user's left hand;

a plurality of depressible electricity manipulating devices each at least in-part exposed on said housing, at
 10 least some of said plurality of electricity manipulating devices positioned on said housing to be within reach of the user's right-hand thumb;

at least one of said electricity manipulating devices is a sensor comprising;

15 a depressible resilient dome cap supporting conductive material in a raised position above circuit traces with said sensor in an open position indicating an Off output, said resilient dome cap depressible to contact said conductive material with said
 20 circuit traces to form a closed position indicating an On output, said conductive material being pressure-sensitive variable-conductance material for creating analog output proportional to varying physical pressure applied by the user's digit; said sensor electrically connected to
 25 active electronics means for interpreting the outputs of said sensor.

16. An electricity manipulating sensor for a control device, said sensor comprising;

a depressible resilient dome cap supporting
 30 conductive material in a raised position above circuit traces with said sensor in an open position indicating an Off output, said resilient dome cap depressible to contact said conductive material with said circuit traces to form a closed position indicating an On
 35 output, said conductive material being pressure-sensitive variable-conductance material for creating analog output

proportional to varying physical pressure applied by the user's digit; said sensor electrically connected to

active electronics means for interpreting the outputs of said sensor.

5 17. An electricity manipulating sensor for a control device according to claim 16 wherein said sensor is depressible by force applied by a single digit of a human user's hand.

10 18. An electricity manipulating sensor for a control device according to claim 17 wherein said active electronics means at least includes an ASIC.

15 19. An electricity manipulating sensor for a control device according to claim 17 wherein said control device is a game control device including a housing to be grasped and held simultaneously by two hands of the human user during use, said housing including a right-hand area and a left-hand area, said right-hand area being an area for at least grasping by the user's right hand, said left-hand area being an area for at least grasping by the user's
20 left hand, said sensor located in said right-hand area to be depressed by the human user's right-hand thumb.

20. A game control comprising
a housing to be grasped and held simultaneously by two hands of a human user, said housing including a right-
25 hand area and a left-hand area, said right-hand area being an area for grasping by the user's right hand, said left-hand area being an area for grasping by the user's left hand;

30 a plurality of depressible electricity manipulating devices each at least in-part exposed on said housing, at least some of said plurality of electricity manipulating devices positioned on said housing to be within reach of the user's right-hand thumb;

35 at least one of said electricity manipulating devices including means for creating an On/Off output, and with varied pressure creating an analog output;

active electronics means for at least interpreting the outputs of said at least one electricity manipulating device.

21. A game control according to claim 20 wherein
5 said electronics means includes an ASIC.

22. A method of manufacturing a game control,
including the steps:

- a) forming a housing shaped to be held simultaneously
by two hands of a human user;
- 10 b) assembling electronics into said housing;
- c) installing electricity manipulating devices
connected to said electronics;
- d) positioning said electricity manipulating devices
in-part exposed on said housing to be depressed by digits
15 of the human user's hand;
- e) installing into said housing at least one
depressible pressure-sensitive analog sensor, said sensor
connected to said electronics, said sensor depressible by
a single digit of a human user's hand.

20 23. A method of manufacturing a game control
according to claim 22 further including the step
installing a resilient dome cap located to be
operational with pressure-sensitive material of said
pressure-sensitive analog sensor.

25 24. A method of manufacturing game controls
according to claim 22 further including the step
installing an injection molded rubber dome cap
located to be operational with said pressure-sensitive
analog sensor.

30 25. A method of manufacturing a game control
according to claim 24 further including the step
installing an individual depressible button for
activating said pressure-sensitive analog sensor.

ABSTRACT OF THE DISCLOSURE

A game controller of the type held in two hands simultaneously for controlling electronic games, including a housing, a plurality of depressible surfaces at least
5 in-part exposed on the housing with the depressible surfaces in operational association with electricity manipulating devices contained within the housing and controlled by depression of the depressible surfaces for manipulating electrical outputs at least in-part useful
10 for controlling electronic games. At least one of the electricity manipulating devices is a pressure-sensitive variable-conductance sensor for creating an analog electrical output proportional to varying physical pressure applied to at least one depressible surface. The
15 analog electrical output is interpreted and utilized in controlling the action intensity of electronic game character imagery. Also disclosed are methods of use and manufacture of game controllers having at least one pressure-sensitive analog sensor.

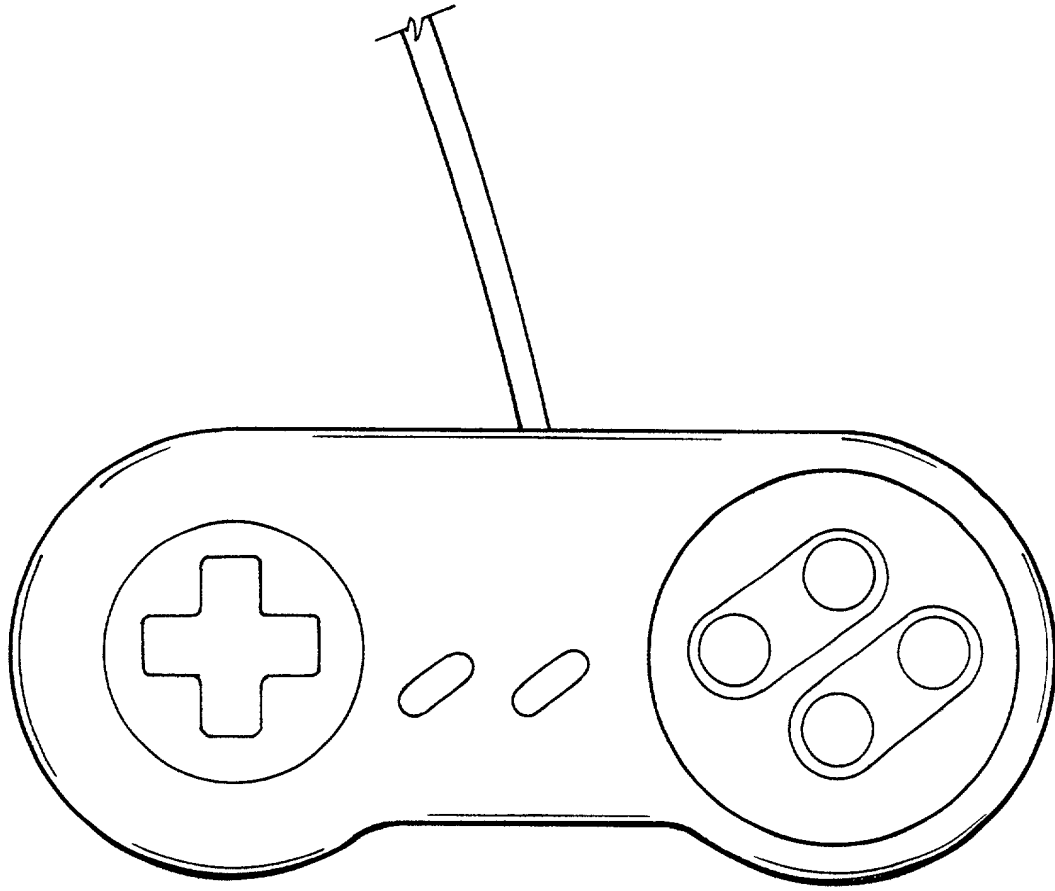


FIG. 1

PRIOR ART

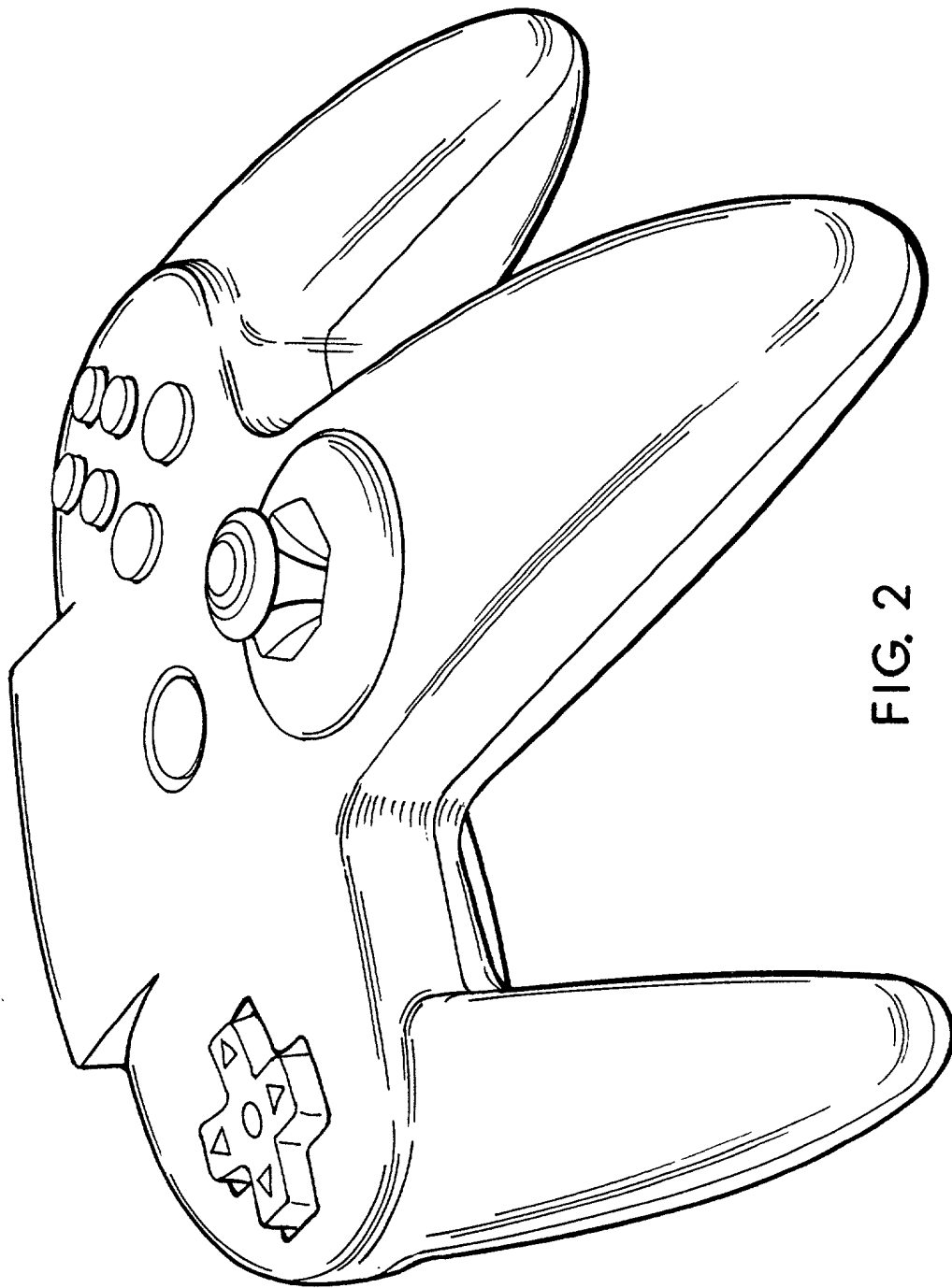
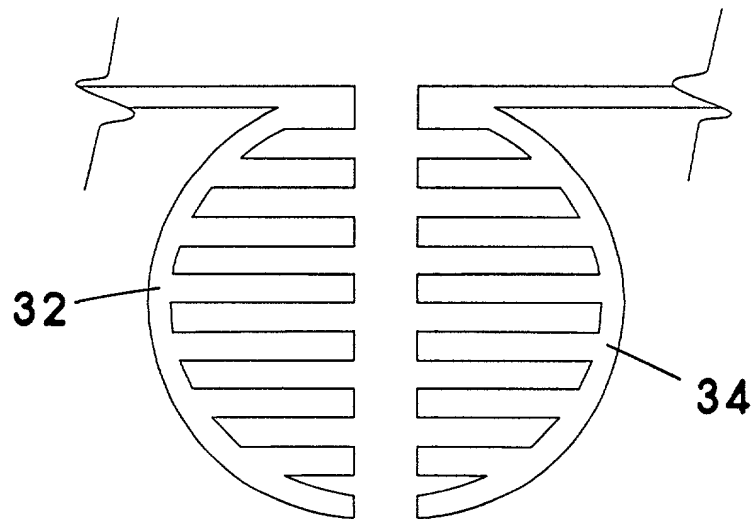
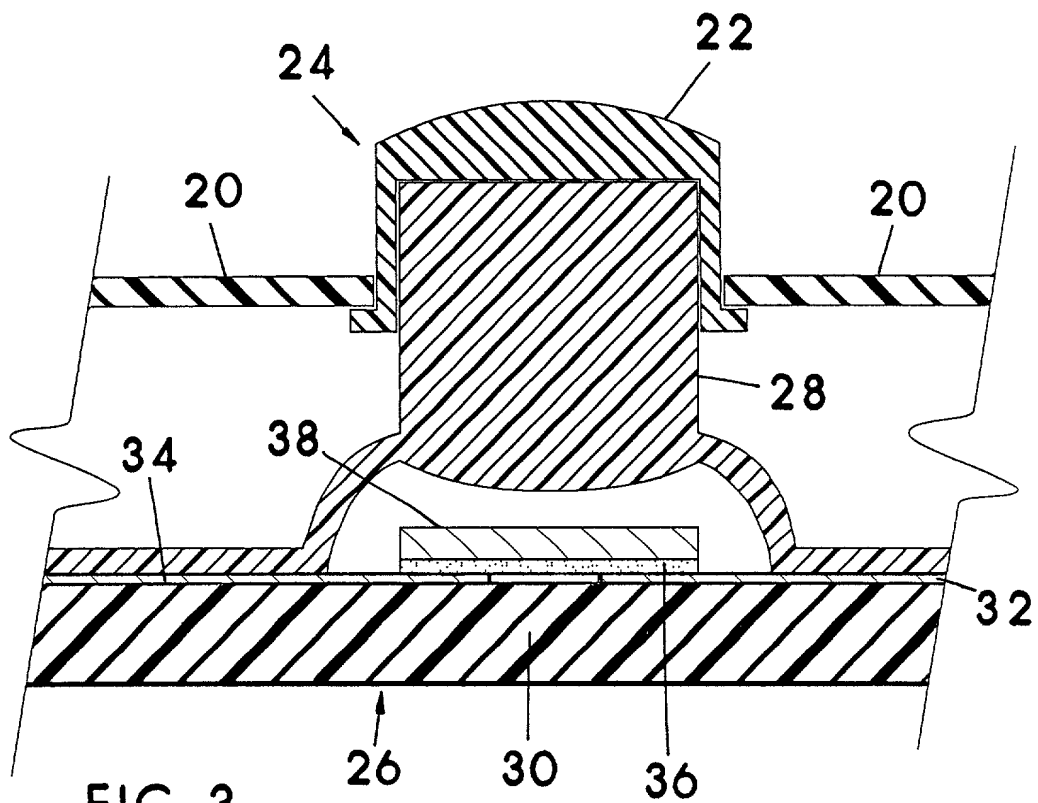


FIG. 2
PRIOR ART



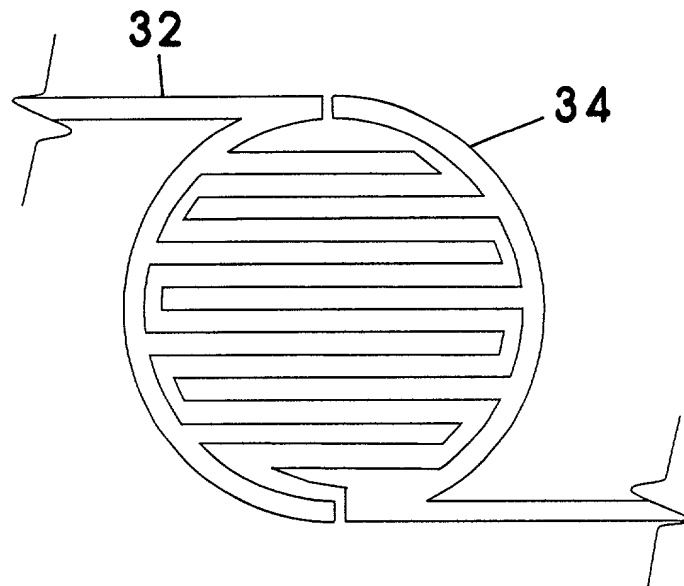
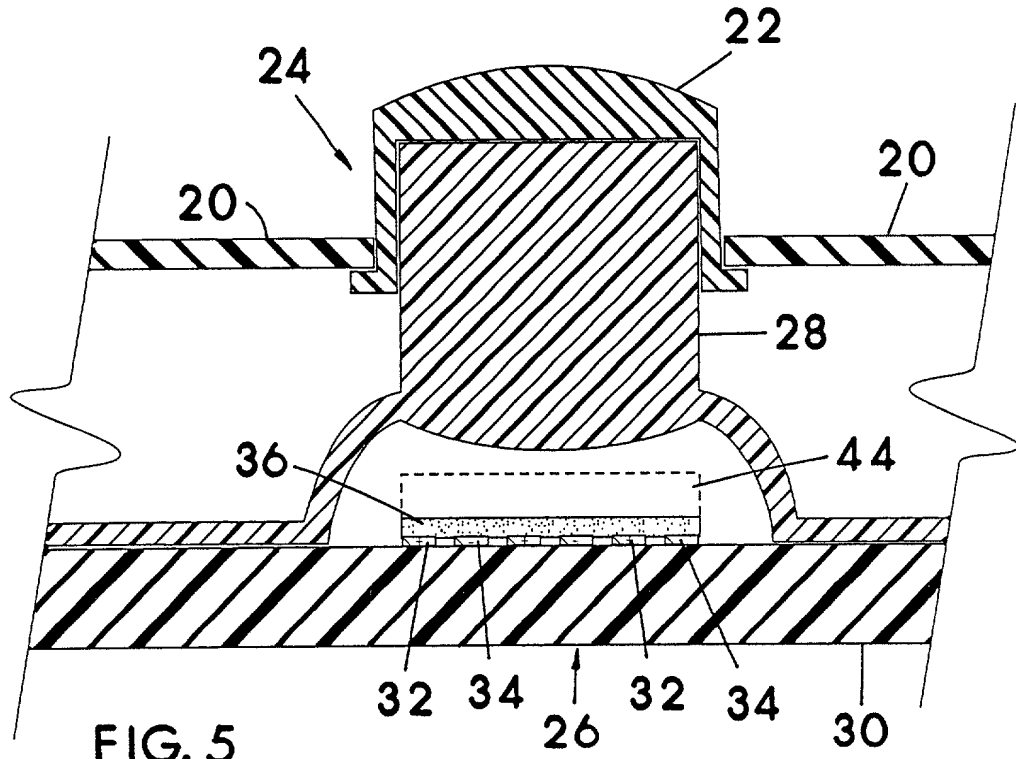


FIG.6

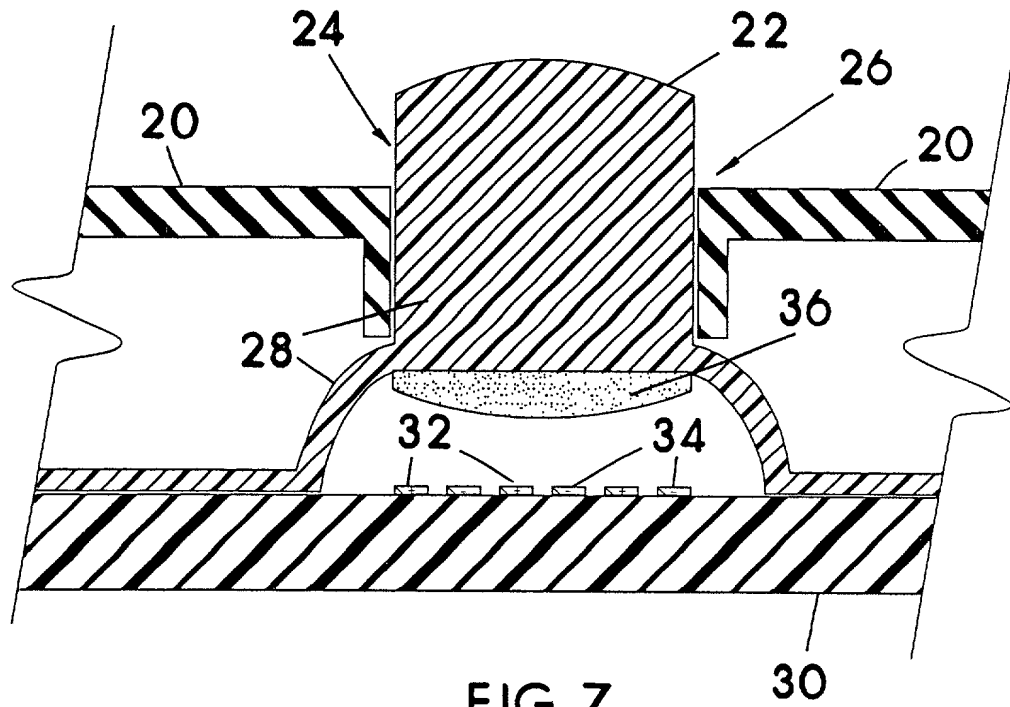


FIG. 7

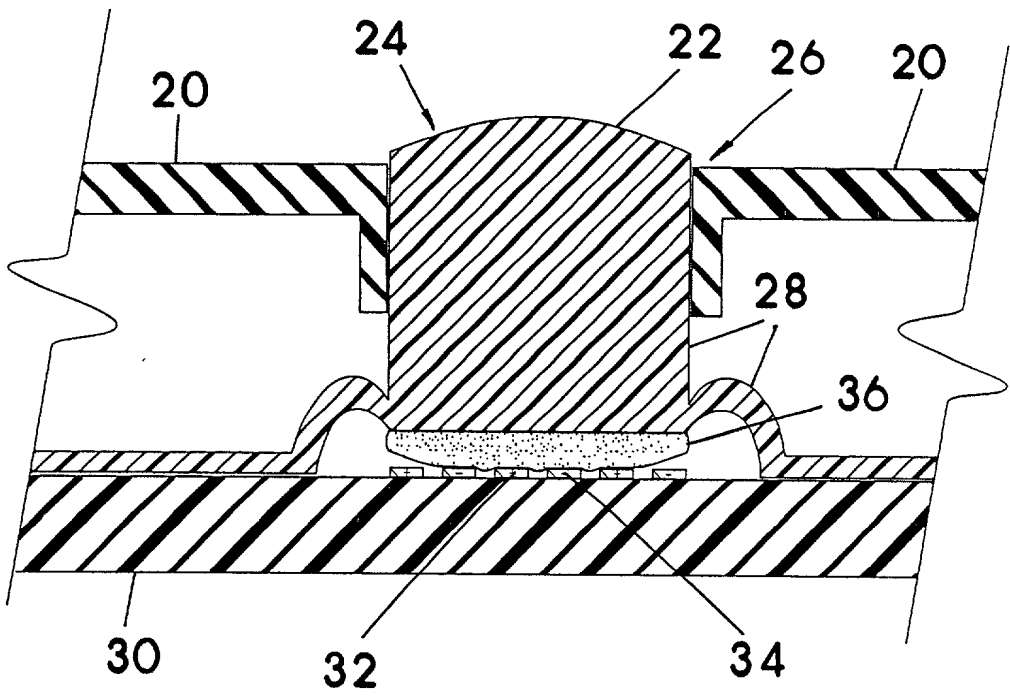


FIG. 8

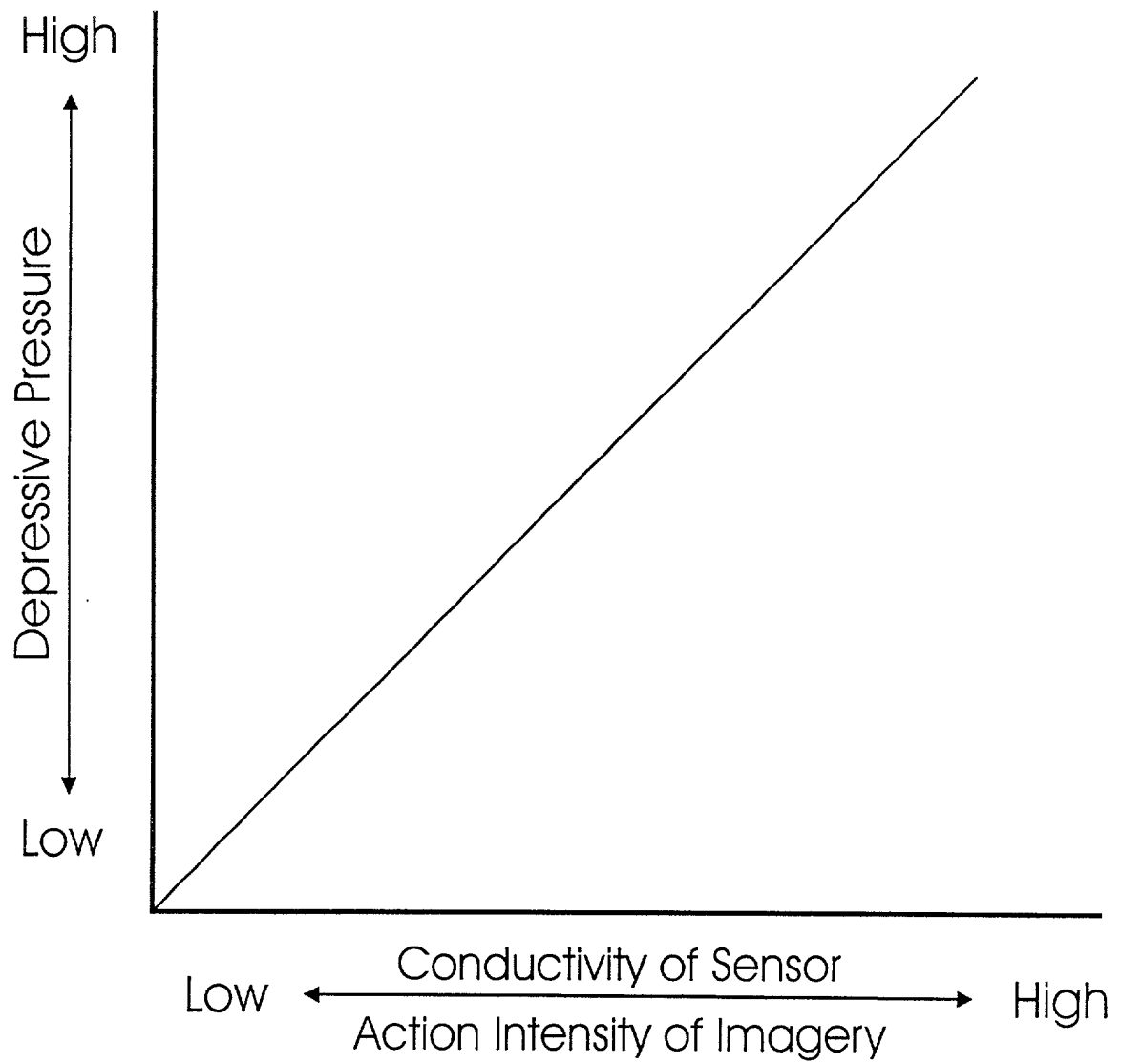


FIG. 10

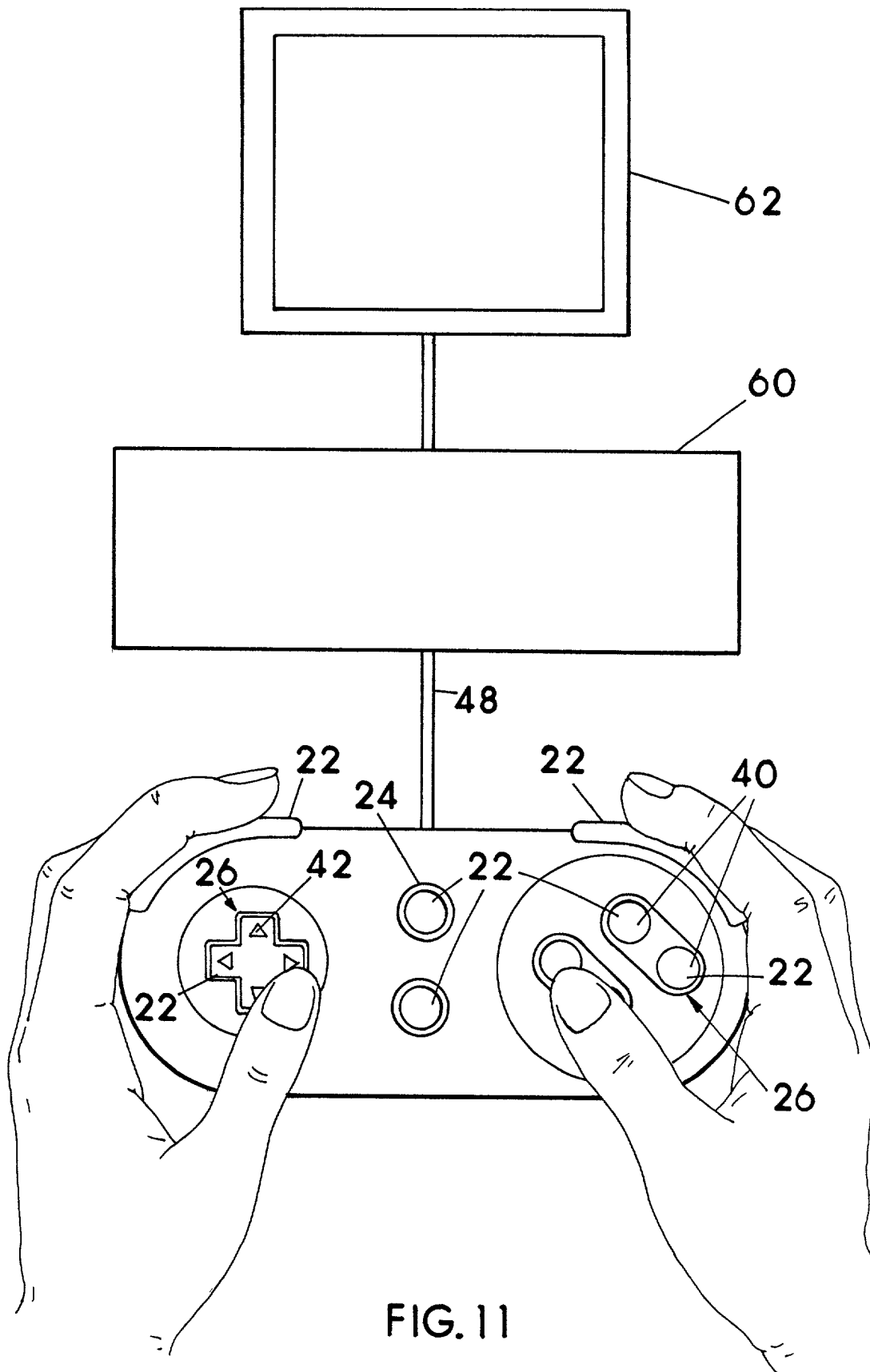


FIG. 11

DECLARATION FOR PATENT APPLICATION

Docket Number (Optional)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled GAME CONTROL WITH ANALOG PRESSURE SENSOR(S), the specification of which

is attached hereto unless the following box is checked:

☐ was filed on _____ as United States Application Number or PCT International Application Number _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Priority Claimed

(Number)	(Country)	(Day/Month/Year Filed)
(Number)	(Country)	(Day/Month/Year Filed)
(Number)	(Country)	(Day/Month/Year Filed)

☐ Yes ☐ No☐ Yes ☐ No☐ Yes ☐ No

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

08/942,450

10/01/1997

pending

(Application Number)

(Filing Date)

(Status - patented, pending, abandoned)

(Application Number)

(Filing Date)

(Status - patented, pending, abandoned)

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Address all telephone calls to Brad A. Armstrong at telephone number 530 782 9148
 Address all correspondence to Brad A. Armstrong
P.O. Box 1419
Paradise, CA 95967

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor (given name, family name) Brad A. ArmstrongInventor's signature Brad A. ArmstrongDate 2-22-00Residence Paradise, CA USACitizenship USAPost Office Address P.O. Box 1419, Paradise, CA 95967

Full name of second joint inventor, if any (given name, family name) _____

Second Inventor's signature _____

Date _____

Residence _____

Citizenship _____

Post Office Address _____



Additional inventors are being named on separately numbered sheets attached hereto.